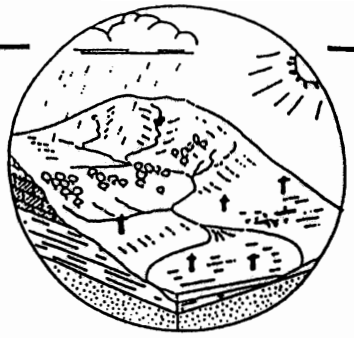
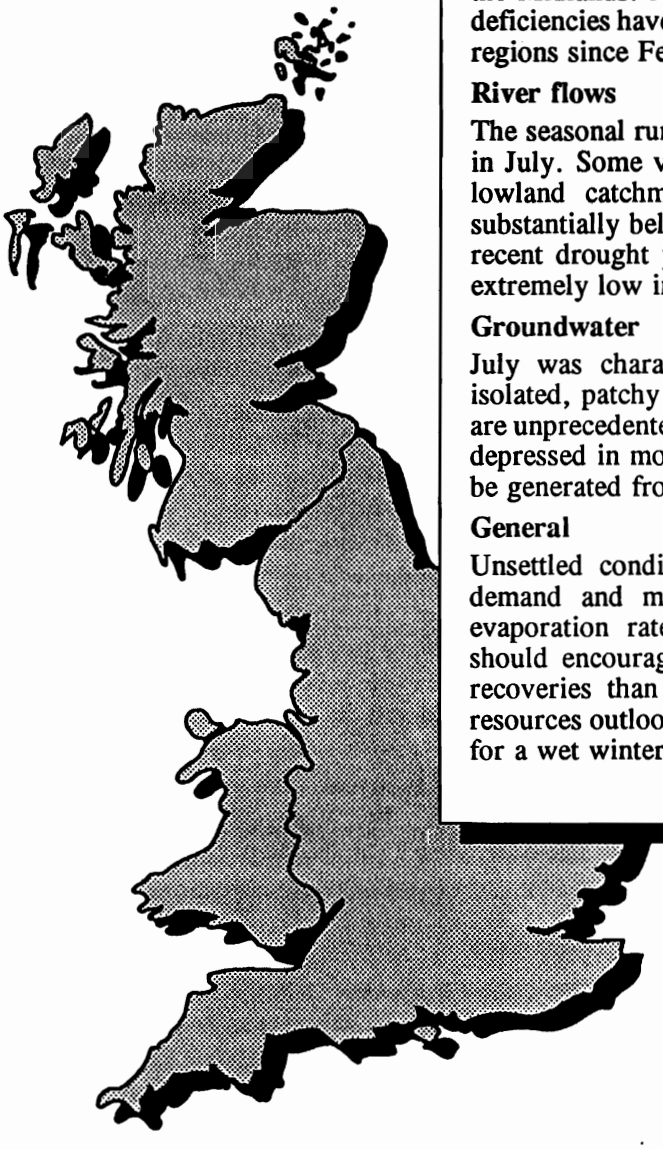
Hydrological Summary for Great Britain





JULY 1992

Rainfall

About 110% of average for GB. Thunderstorms contributed to substantial rainfall totals in parts of eastern England and the Midlands. Much of northern Scotland was dry. Rainfall deficiencies have decreased over most of the drought afflicted regions since February but they remain exceptional.

River flows

The seasonal runoff decline was arrested in most catchments in July. Some very minor flooding occurred in impervious lowland catchments. Generally, July runoff totals were substantially below average but appreciably above those for recent drought years. Long term runoff accumulations are extremely low in eastern and southern England.

Groundwater

July was characterised by gentle recessions and a little isolated, patchy recharge. In the Chalk, groundwater levels are unprecedented over wide areas. Water-tables remain very depressed in most aquifers. The 1992 recovery will need to be generated from an exceptionally low base.

General

Unsettled conditions since late June have reduced water demand and moderated the drought's impact. Declining evaporation rates and relatively moist late-summer soils should encourage an earlier onset of runoff and recharge recoveries than in 1988-91. Nonetheless the groundwater resources outlook for 1993 remains very fragile and the need for a wet winter is undiminished.

Institute of Hydrology

British Geological Survey

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HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - July 1992

Data for this report have been provided principally by the regional divisions of the National Rivers Authority in England and Wales, the River Purification Boards in Scotland and by the Meteorological Office. Reservoir contents information has been supplied by the Water Services Companies, the NRA or, in Scotland, the Lothians Regional Council. The most recent areal rainfall figures are derived from a restricted network of raingauges (particularly in Scotland) and a proportion of the river flow data is of a provisional nature.

A map (Figure 4) is provided to assist in the location of the principal monitoring sites.

Rainfall

July was substantially wetter than May or June in most areas but the pattern of lengthy dry spells punctuated by wet, or very wet, interludes persisted. A large proportion of the July rainfall, in southern Britain especially, was associated with storms early in the month and again on the 20/21st; provisional data suggest that the 11th and the 20th were the wettest days of the year thus far nationwide. Thundery activity was widespread and localised surface flooding together with significant transport disruption was widely reported. Although weather conditions remained unsettled until the final week, rainfall, aside from the storm events, was mostly light and patchy.

Reflecting the substantial convectional component in southern Britain, rainfall totals for July showed large spatial variations. Regionally however the distribution favoured the English lowlands with East Anglia registering around 50 percent above average. Some districts where the drought has achieved its greatest severity (e.g. inland from the Wash and the East Midlands) recorded approximately twice the July average. In contrast, parts of northern Scotland were notably dry. On a nationwide basis, the rainfall distribution was very atypical especially by comparison with that which has characterised Britain for much of the last four years.

Rainfall totals for the last three months are above average throughout most of the English lowlands, appreciably so in parts of East Anglia, but significantly below the May-July mean in the South-West, northern England and eastern Scotland where the Central Lowlands have been especially dry, some areas having only a little over half the average. The mostly unsettled conditions since February have made only a relatively modest impact on the English lowland drought - in rainfall terms some amelioration is evident but hydrologically the drought remains severe (rainfall in the summer half-year having little or no immediate impact on runoff and, particularly, recharge rates).

Apart from the South-West, 1992 rainfall totals for the English regions are near average; the drought is largely a legacy of a shortage of rainfall stretching back in some areas to the spring of 1988. For England and Wales, rainfall since February 1990 has been the lowest (for any 29-month accumulation) since the 1850s. Table 2 lists the shortfalls in the 12-, 29- and 48-month timeframes. The associated return periods testify to large spatial and temporal variations in severity; deficiencies in parts of the lowlands remain the equivalent of a year's average rainfall.

Spring and summer rainfall has been very valuable in moderating water demand and reducing the drought's impact on the community (certainly compared with 1976 and 1990). Lowland rainfall from March has been considerably greater than in the previous three years but the need for a wet autumn and winter to produce a sustainable recovery in runoff and recharge rates, and improve the water resources outlook for 1993, remains undiminished.

Evaporation and Soil Moisture deficits (SMDs)

Following notably warm conditions in May and June, July temperatures were well within the normal range albeit marginally above average for Britain as a whole. The cloudy, unsettled weather over the first three weeks also resulted in modest sunshine totals in most areas. Consequently MORECS evaporation losses were close to the long term average but remain notable for the last three months and for the year as a whole (though well short of the corresponding figures for 1989 and 1990).

Soil moisture deficits generally increased sporadically through the month but by month-end there was little areal coherence in much of southern Britain due to the thundery rainfall. Relative to the late July average, SMDs are high in northern England and parts of eastern Scotland but near average in much of the English lowlands (the area adjacent to the Thames Estuary is an exception) and substantially less dry than in 1989 and 1990. Dry soil conditions have been a major factor in delaying the recovery in runoff and recharge rates in the autumns of the last four years; early August SMDs in 1992 provide some grounds for optimism regarding a more typical onset of the seasonal recovery this year.

Runoff

Except in Northern Scotland, July runoff totals were typically a little greater than those for June and the shrinkage of headwater streams in eastern England has slowed. The arrest, or reversal, of the normal seasonal decline in runoff left July mean flows well within the normal range (although substantially below average) in most catchments. Even in those regions where the drought is most severe, July mean flows were appreciably greater than in the drought years of 1990, 1989 and 1976. Some minor spate conditions were reported in impervious lowland catchments where thunderstorms, on the 20th especially, resulted in very brisk flow increases. A few flood alerts were called in London - high flows were recorded on the Brent and the Silk Stream overtopped its banks.

Notably low runoff totals for the summer thus far were registered in responsive catchments in northern England and parts of Scotland as well as in English lowland rivers supported principally from groundwater. The drought's severity is, however, less evident in relation to minimum recorded flows than as indicated by long term runoff accumulations.

A remarkable feature of certain of the monthly hydrographs presented on Figure 2 is the limited seasonal flow variation over the last year - see, for instance, the Rivers Lee and Itchen. Runoff rates have remained depressed since the late summer of 1988 in parts of the eastern lowlands and, in the longest timeframes, accumulated runoff totals are without recorded precedent. Two- and four-year runoff totals, especially for permeable catchments, are particularly modest. In Hampshire, the 24- and 48-month runoff totals for the Test and Itchen are well below any registered prior to the current drought. In the Anglian region, the Little Ouse and Lud present a similar picture. On the Yorkshire Derwent four of the five lowest July runoff totals, in a 30-year record, have been registered since 1988. Table 3 confirms the wide distribution of catchments registering unprecedented runoff accumulations over the full compass of the drought. One effect of the drought has been to produce 95% exceedance flows (for the last four years) substantially lower - typically 20-30% in the lowlands - than for the preceding record.

Rainfall and demand patterns were more influential than is normal for mid-summer in determining the net drawdown in reservoir contents through July. In the English lowlands stocks remain generally healthy (in contrast to groundwater). Limited rainfall over the last three months has produced a relatively steep decline in reservoir contents in much of northern and western Britain, in these regions stocks are appreciably lower than in early August 1991.

Groundwater

In general terms, groundwater levels are falling throughout the United Kingdom, a normal state of affairs in late-July and August. However, slight rises have been noted in three Chalk index wells, Washpit Farm, Redlands Hall and Chilgrove House (near Compton House) in southern England. Since these very slight upturns are not seen elsewhere and because these wells are not noted for their rapid response, it is thought that they may be located in areas of locally accentuated rainfall. Certainly reports of modest recharge to shallow aquifers have been received.

Groundwater levels in the zone from southern Yorkshire through East Anglia and into the eastern extremity of Kent remain near to or below the recorded seasonal minima. Only the very slight upturn noted at Washpit Farm prevented a new record low for any month at this site. Throughout most of the eastern Chalk levels are below the pre-1992 minimum for the summer. Throughout 1992 the water-table at Redlands and Washpit Farm has remained below any level registered prior to 1991. The Therfield Rectory well (not featured on Figure 3) was again reported as dry in July; prior to this year the well was last dry in early-1923. The dry zone across the Midland belt persists, with the Weeford Flats borehole still dry, and the levels at Llanfair DC near to the recorded seasonal minimum.

Elsewhere, groundwater levels are generally below the seasonal mean values, often well below. At only two sites, West Woodyates and West Dean in the southern Chalk, are levels close to the seasonal mean. Even in the Dumfries basin of Scotland and in Northern Ireland, levels seem to be below the seasonal average.

No significant replenishment of aquifers may be expected before October 1992 (at the earliest) in lowland areas. While recessions starting at low levels are usually much shallower than when starting at high levels, by the autumn, groundwater levels will probably have fallen a little below the 1990 or 1991 minima. Dwellings and small holdings dependent for water supplies on shallow wells remain vulnerable to falling groundwater levels, and more may be expected to fail before the onset of winter recharge.

By their nature, groundwater droughts tend to be persistent and with the 1992 recoveries expected to begin with water-tables standing below the normal spring levels by a depth roughly equivalent to two years of average recharge, no early termination is possible. Where the decline in water-tables has been accelerated by groundwater pumping, the outlook is even less encouraging. An exceptionally wet 1992/93 winter will be necessary to restore groundwater levels to their normal (pre-1990) state; a further dry winter will be a matter for serious concern.

Institute of Hydrology/British Geological Survey
13 August 1992

TABLE 1 1991/92 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		July	Aug	Sept	Oct	Nov	Dec 1991	Jan 1992	Feb	Mar	Apr	May	June	July
England and Wales	mm	68	31	62	77	95	49	48	41	70	75	49	45	87
	%	93	34	75	93	98	54	56	64	119	129	73	74	119
NRA REGIONS														
North West	mm	67	65	69	125	169	119	57	97	139	89	62	31	76
	%	65	52	56	106	140	99	51	120	193	116	76	37	74
Northumbria	mm	53	36	42	75	109	78	33	46	106	103	31	19	66
	%	69	36	53	100	116	104	41	70	204	187	48	31	85
Severn-Trent	mm	77	21	54	55	68	39	59	31	67	50	59	55	87
	%	118	26	81	85	86	56	86	58	129	96	92	98	134
Yorkshire	mm	36	21	40	63	94	62	47	41	89	66	34	33	86
	%	51	23	56	91	106	84	61	64	168	118	56	57	123
Anglian	mm	38	18	63	26	54	24	45	17	62	43	48	34	85
	%	67	28	121	50	87	45	86	39	155	108	102	69	150
Thames	mm	79	18	52	36	66	16	28	25	51	65	60	39	73
	%	132	26	84	56	90	24	45	53	111	141	107	75	121
Southern	mm	88	15	51	51	81	23	18	33	59	84	30	26	66
	%	149	21	72	65	86	28	24	58	113	175	55	52	112
Wessex	mm	73	19	71	83	72	30	36	39	55	81	24	49	70
	%	118	23	90	101	74	33	43	66	95	150	35	91	113
South West	mm	90	32	85	123	112	52	44	68	75	100	31	23	80
	%	107	32	82	109	84	39	34	76	89	141	37	35	96
Welsh	mm	97	54	85	154	142	65	76	79	114	91	80	48	92
	%	102	45	68	119	99	45	56	82	131	107	88	59	97
Scotland	mm	91	67	131	165	227	141	139	165	208	123	80	52	103*
	%	81	52	96	111	160	90	101	159	226	137	88	57	92
RIVER PURIFICATION BOARDS														
Highland	mm	105	86	182	193	305	166	197	225	250	138	105	46	99
	%	83	58	115	104	180	85	120	169	219	121	102	42	78
North-East	mm	57	34	58	120	133	53	67	51	119	68	57	50	60
	%	62	32	67	124	129	52	74	69	192	111	74	71	65
Tay	mm	93	40	111	155	154	97	117	106	159	90	57	30	79
	%	91	34	97	127	129	72	99	115	194	120	60	36	77
Forth	mm	97	38	103	111	124	108	110	110	129	76	45	25	73
	%	99	33	95	105	115	99	111	143	187	112	54	33	75
Tweed	mm	65	36	67	101	127	92	63	69	134	98	52	27	68
	%	73	32	71	115	122	102	68	100	231	161	68	40	76
Solway	mm	77	69	81	172	203	162	91	148	205	144	66	30	87
	%	70	53	54	119	140	107	65	159	225	164	72	33	79
Clyde	mm	108	87	157	193	274	208	170	234	274	144	93	41	99
	%	83	61	90	105	164	112	106	207	261	140	96	40	77

Note: The most recent monthly rainfall figures correspond to the MORECS areal assessments derived by the Meteorological Office. The regional areal rainfall figures are regularly updated (normally one or two months in arrears) using figures derived from a far denser raingauge network.

* Based on 13 raingauges; given the notable variation in rainfall across Scotland in July this figure should be treated with particular caution.

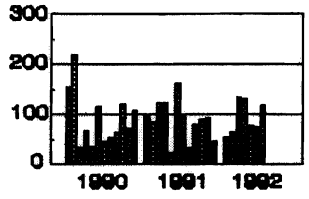
TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

		Jan - Jul92		Aug91-Jul92		Mar90-Jul92		Aug88-Jul92	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales	mm	415		729		1768		3190	
	% LTA	88	2-5	80	10-20	83	40-60	87	35-55
NRA REGIONS									
North West	mm	551		1098		2528		4554	
	% LTA	90	2-5	90	2-5	89	5-10	94	5
Northumbria	mm	404		744		1828		3044	
	% LTA	89	2-5	85	5-10	88	5-15	87	30-40
Severn Trent	mm	408		645		1525		2714	
	% LTA	99	<2	83	5-10	83	30-40	88	15-25
Yorkshire	mm	396		676		1617		2843	
	% LTA	90	2-5	81	5-15	82	40-60	85	40-60
Anglian	mm	334		519		1149		2006	
	% LTA	102	2-5	85	5-10	79	80-110	82	140-180
Thames	mm	341		529		1290		2350	
	% LTA	92	2-5	75	15-25	77	80-120	83	50-80
Southern	mm	316		537		1461		2612	
	% LTA	80	5-10	68	50-70	79	40-60	82	80-110
Wessex	mm	354		629		1580		2957	
	% LTA	81	5-10	72	30-40	78	60-90	85	30-45
South West	mm	421		825		2255		4260	
	% LTA	69	20-30	69	50-80	81	35-50	89	10-20
Welsh	mm	580		1080		2645		4902	
	% LTA	86	2-5	81	10-20	85	15-25	92	5-10
Scotland	mm	870		1601		3713		6493	
	% LTA	121	10-20	112	5-10	111	10-20	113	80-110
RIVER PURIFICATION BOARDS									
Highland	mm	1060		1992		4643		8179	
	% LTA	123	10-20	116	10-20	113	20-30	119	>200
North-East	mm	472		870		2207		3658	
	% LTA	90	2-5	85	5-15	92	5-10	89	20-30
Tay	mm	638		1195		2905		5269	
	% LTA	99	<2	95	2-5	92	<2	105	2-5
Forth	mm	568		1052		2643		4680	
	% LTA	100	<2	94	2-5	101	2-5	105	2-5
Tweed	mm	511		934		2258		3779	
	% LTA	99	<2	93	2-5	96	2-5	94	5
Solway	mm	771		1459		3336		5915	
	% LTA	110	2-5	102	2-5	100	<2	104	2-5
Clyde	mm	1056		1974		4519		7889	
	% LTA	130	30-40	119	15-25	117	50-80	118	>200

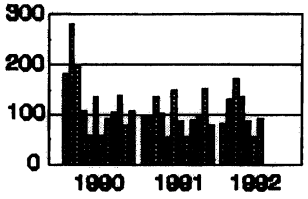
Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less - for the longest durations the return period estimates converge. "Wet" return periods underlined.
The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate.

* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office (HMSO).

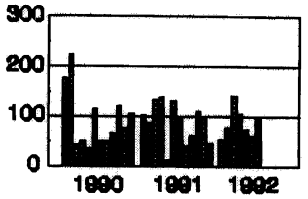
FIGURE 1. MONTHLY RAINFALL FOR 1990-1992 AS A PERCENTAGE OF THE 1941-1970 AVERAGE



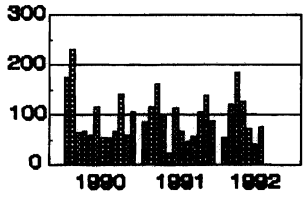
England and Wales



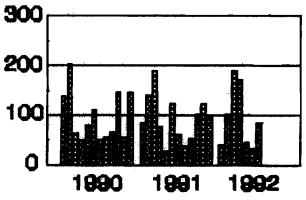
Scotland



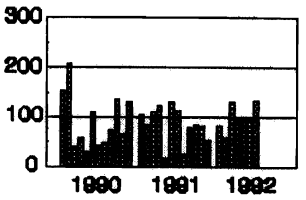
Welsh Region



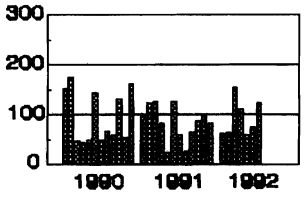
North West Region



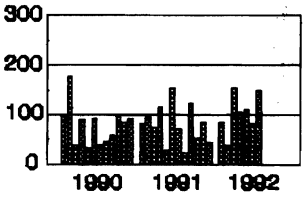
Northumbria Region



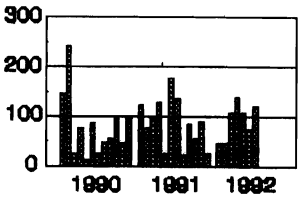
Severn-Trent Region



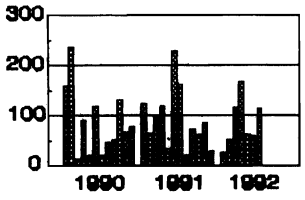
Yorkshire Region



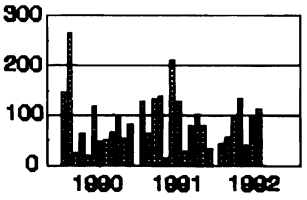
Anglian Region



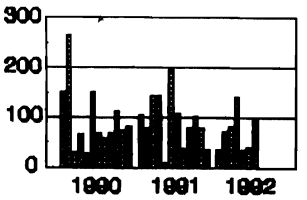
Thames Region



Southern Region

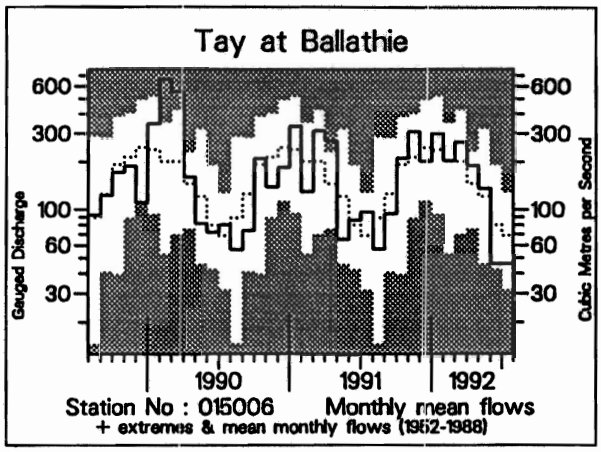


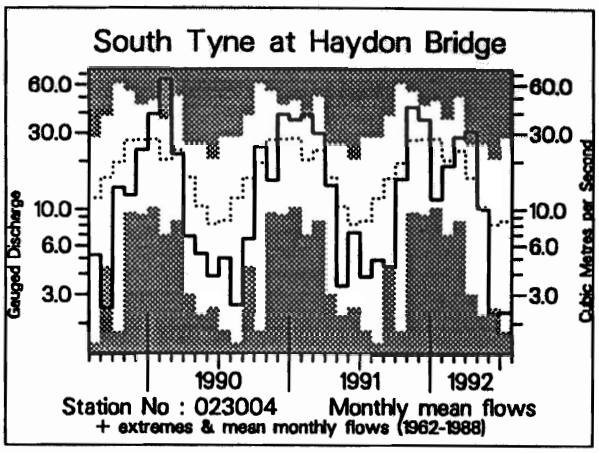
Wessex Region

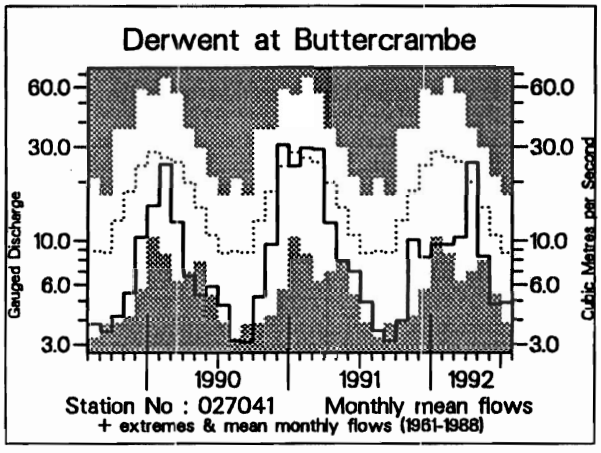


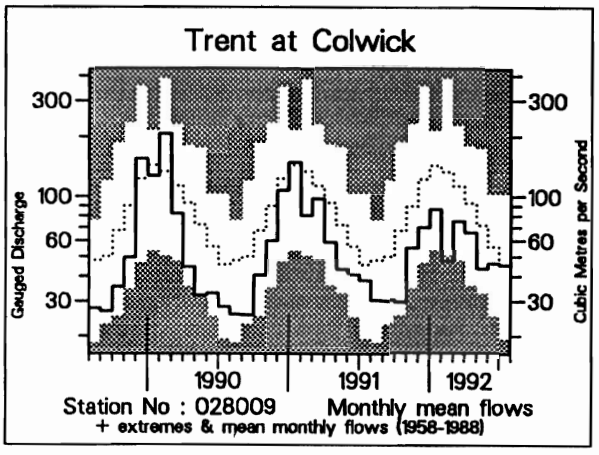
South West Region

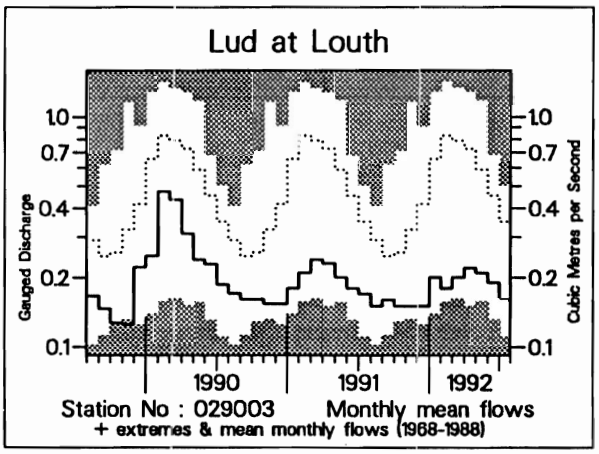
FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

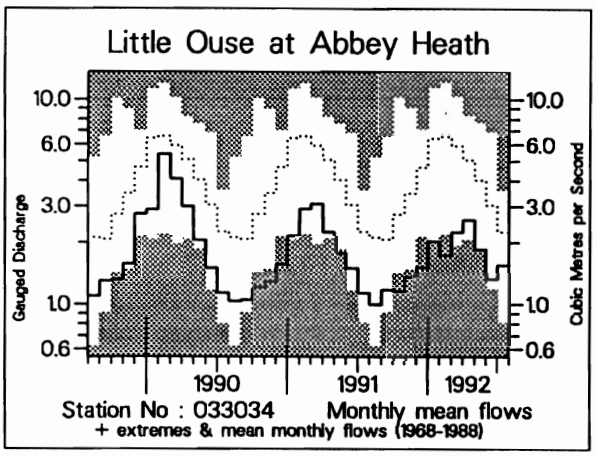


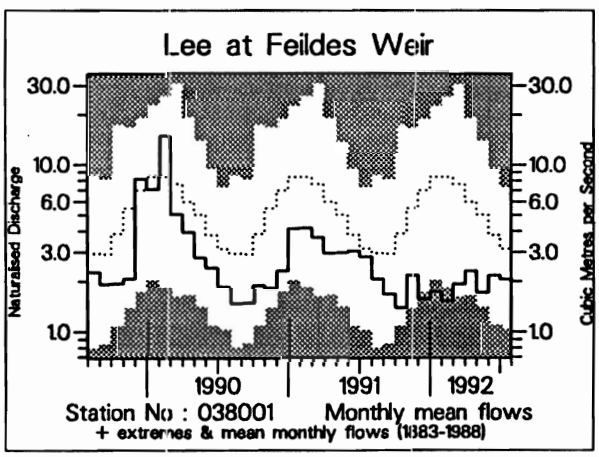


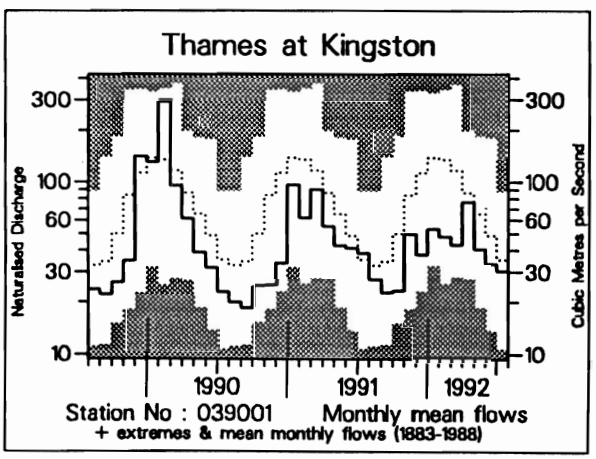


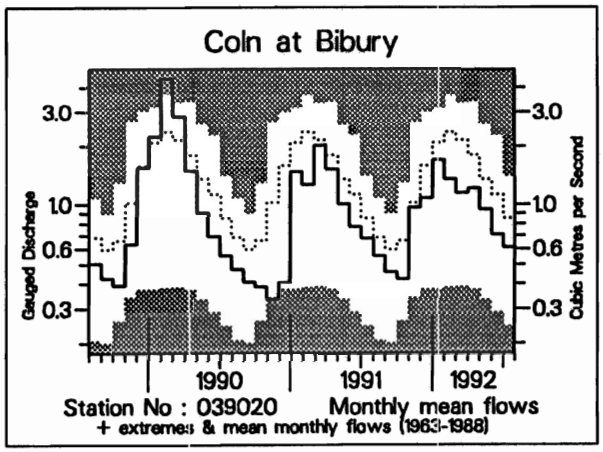


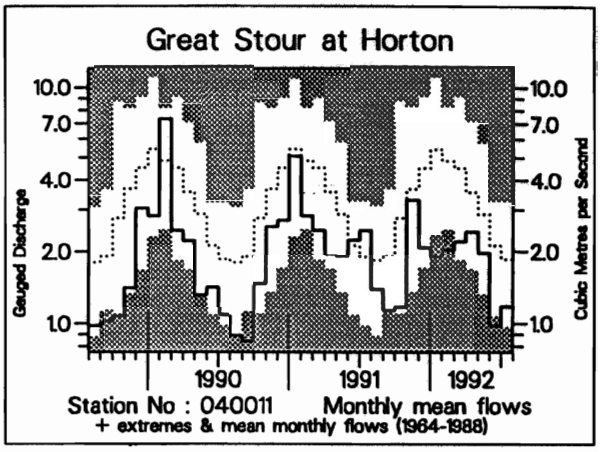


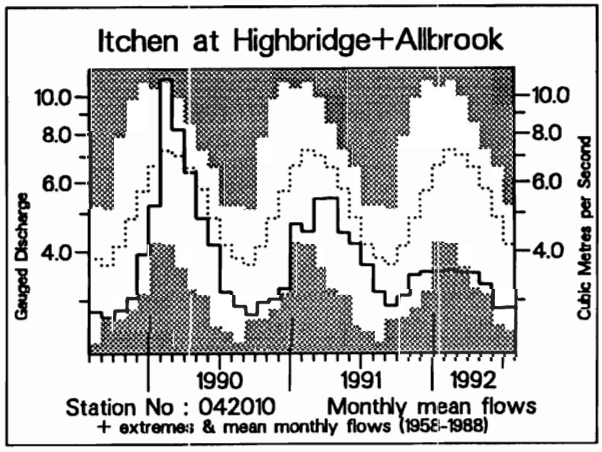


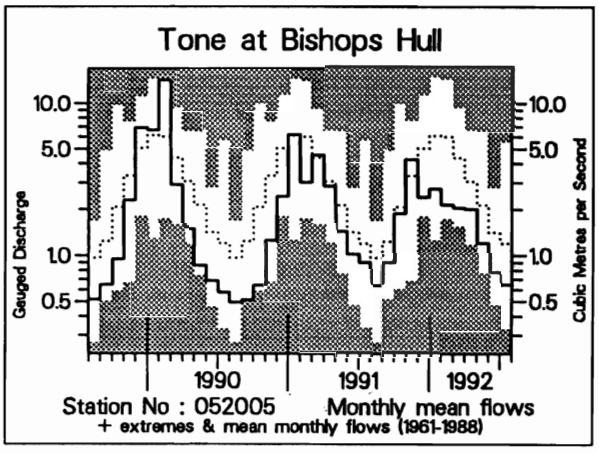


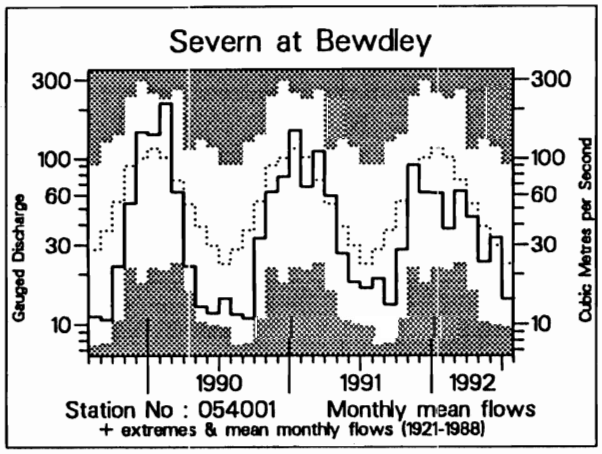


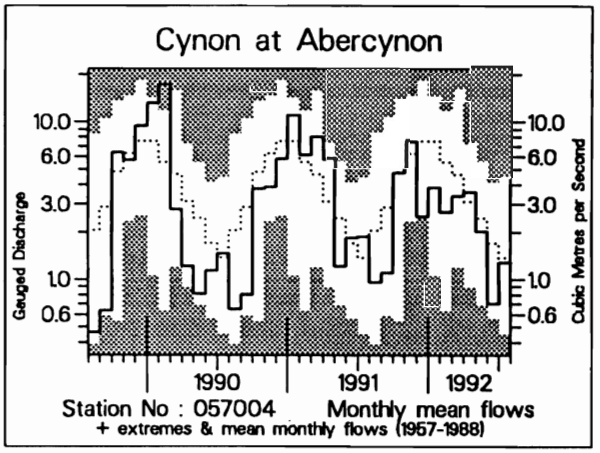

Coln at Bibury
3.0
1.0
0.6
0.3
Gauged Discharge
Cubic Metres per Second
1990
1991
1992
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

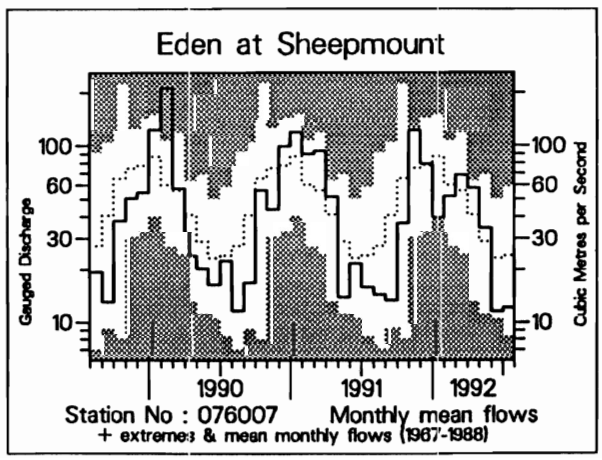

Great Stour at Horton
10.0
7.0
4.0
2.0
1.0
Gauged Discharge
Cubic Metres per Second
1990
1991
1992
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1988)


Itchen at Highbridge+Allbrook
10.0
8.0
6.0
4.0
Gauged Discharge
Cubic Metres per Second
1990
1991
1992
Station No : 042010 Monthly mean flows
+ extremes & mean monthly flows (1958-1988)


Tone at Bishops Hull
10.0
5.0
1.0
0.5
Gauged Discharge
Cubic Metres per Second
1990
1991
1992
Station No : 052005 Monthly mean flows
+ extremes & mean monthly flows (1961-1988)


Severn at Bewdley
300
100
60
30
10
Gauged Discharge
Cubic Metres per Second
1990
1991
1992
Station No : 054001 Monthly mean flows
+ extremes & mean monthly flows (1921-1988)


Cynon at Abercynon
10.0
6.0
3.0
1.0
0.6
Gauged Discharge
Cubic Metres per Second
1990
1991
1992
Station No : 057004 Monthly mean flows
+ extremes & mean monthly flows (1957-1988)


Eden at Sheepmount
100
60
30
10
Gauged Discharge
Cubic Metres per Second
1990
1991
1992
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1988)

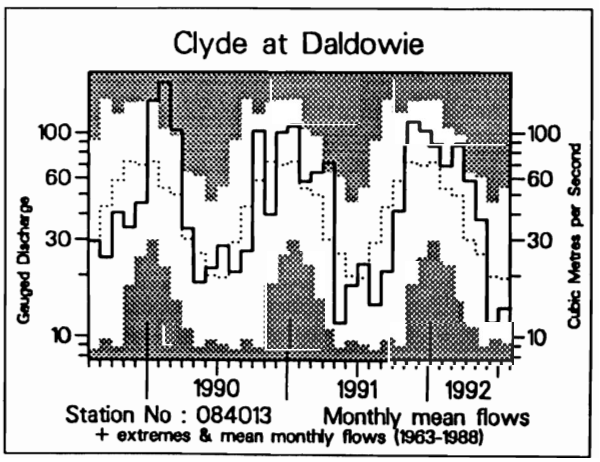

Clyde at Daldowie
100
60
30
10
Gauged Discharge
Cubic Metres per Second
1990
1991
1992
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

River/ Station name	Mar 1992	Apr 1992	May 1992	Jun 1992	Jul 1992		1/92 to 7/92		8/91 to 7/92		8/90 to 7/92		8/88 to 7/92	
	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs
Dee at Park	65 68	95 123	54 87	15 40	14 49	5 /20	340 74	3 /20	609 78	2 /19	1367 86	3 /18	2725 85	1 /16
Tay at Ballathie	154 121	106 125	79 115	26 58	27 67	8 /40	679 108	27 /40	1179 104	28 /39	2302 102	24 /38	5301 118	32 /36
Whiteadder Water at Hutton Castle	41 81	79 218	16 60	9 53	8 63	5 /23	213 85	7 /23	301 77	6 /22	749 95	9 /21	1204 75	4 /19
South Tyne at Haydon Bridge	100 118	105 195	36 103	8 30	8 28	4 /29	360 90	9 /29	724 95	11 /27	1488 97	12 /25	2808 90	4 /21
Wharfe at Flint Mill Weir	96 126	64 118	32 86	10 40	11 41	5 /37	322 82	9 /37	595 82	6 /36	1234 85	7 /35	2530 87	3 /33
Derwent at Buttercrambe	18 44	40 129	14 59	8 48	8 57	4 /31	119 57	2 /31	168 52	3 /30	442 67	4 /29	828 62	1 /27
Trent at Colwick	27 67	23 72	16 64	16 85	16 101	23 /34	144 65	2 /34	220 62	2 /33	488 69	1 /32	1072 75	2 /30
Lud at Louth	10 28	10 32	10 38	9 45	8 50	2 /24	65 35	2 /24	101 39	2 /24	206 41	1 /23	515 50	1 /21
Witham at Claypole Mill	11 42	9 43	8 51	6 62	7 100	22 /34	65 50	4 /33	91 51	3 /33	206 56	2 /32	467 63	2 /30
Little Ouse at Abbey Heath	9 41	10 55	7 48	5 47	6 73	7 /25	50 43	2 /24	73 43	1 /24	151 45	1 /23	412 61	1 /21
Colne at Lexden	8 44	7 53	5 58	4 74	4 96	15 /33	39 44	4 /33	58 43	4 /32	122 46	2 /31	348 64	1 /29
Lee at Feildes Weir (natr.)	5 25	6 40	4 31	5 53	5 62	19 /107	34 32	3 /106	56 35	3 /105	139 43	4 /103	419 65	4 /99
Thames at Kingston (natr.)	12 39	20 89	11 63	9 71	8 84	42 /110	85 53	8 /110	128 52	8 /109	272 56	5 /108	694 70	6 /106
Coln at Bibury	29 54	29 67	24 73	17 64	15 72	7 /29	188 68	4 /29	274 71	6 /28	537 68	2 /27	1204 76	2 /25
Great Stour at Horton	17 51	18 69	15 71	7 45	9 63	5 /28	96 53	2 /26	165 57	1 /25	371 63	1 /23	753 64	1 /19
Itchen at Highbridge+Allbrook	26 50	25 54	24 57	20 58	21 69	2 /34	169 57	1 /34	287 63	1 /33	631 69	1 /32	1400 76	1 /30
Piddle at Baggs Mill	25 44	29 68	24 76	17 73	15 84	9 /29	159 57	2 /28	270 68	3 /27	566 70	1 /25	1229 75	1 /21
Exe at Thorverton	68 80	53 94	36 97	13 55	15 71	14 /37	270 59	3 /36	558 68	2 /36	1289 78	3 /35	2748 83	3 /33
Taw at Umberleigh	45 66	40 91	28 97	8 51	7 46	13 /34	202 54	3 /34	428 62	2 /33	1067 77	2 /32	2352 86	3 /30
Tone at Bishops Hull	27 47	26 67	16 59	10 57	8 52	3 /32	149 49	2 /31	280 60	2 /31	608 65	1 /30	1463 77	1 /28
Severn at Bewdley	39 84	26 82	15 64	20 115	9 64	17 /72	168 64	6 /71	297 66	6 /71	686 76	8 /70	1514 84	6 /68
Wye at Cefn Brwyn	317 180	128 100	113 120	41 48	44 40	10 /39	921 91	11 /37	1875 92	9 /35	3878 94	8 /30	7922 95	4 /20
Cynon at Abercynon	85 70	87 114	51 87	17 42	32 93	21 /34	432 66	5 /34	848 68	3 /32	2104 84	5 /30	4709 94	10 /26
Dee at New Inn	246 137	113 106	83 128	40 68	29 43	8 /24	727 83	7 /23	1420 79	3 /23	3054 85	2 /22	6534 90	2 /20
Eden at Sheepmount	80 114	65 141	40 126	13 51	14 52	4 /22	315 84	5 /22	619 91	8 /20	1340 98	9 /18	2774 102	7 /14
Clyde at Daldowie	121 161	79 182	53 155	16 61	19 69	9 /29	499 127	28 /29	896 116	23 /28	1778 115	22 /27	3581 117	22 /25

Notes:
(i) Values based on gauged flow data unless flagged (natr.), when naturalised data have been used.
(ii) Values are ranked so that lowest runoff as rank 1.
(iii) %LT means percentage of long term average from the start of the record to 1991. For the long periods (at the right of this table), the end date for the long term is 1991.

TABLE 4 START-MONTH RESERVOIR STORAGES UP TO AUGUST 1992

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1992 Mar	Apr	May	Jun	Jul	Aug	1991 Aug
North West	Northern Command Zone[1]	(G)	133375	80	94	93	86	66	55	58
	Vyrnwy	(R)	55146	88	100	100	94	89	80	91
Northumbria	Teesdale[2]	(G)	87936	89	96	97	89	71	58	52
	Kielder	(R)	199175*	94*	92*	91*	90*	86*	77*	92*
Severn-Trent	Clywedog	(R)	44922	85	99	99	97	93	85	94
	Derwent Valley[3]	(G)	39525	92	100	100	91	79	73	66
Yorkshire	Washburn[4]	(G)	22035	83	90	99	95	85	72	59
	Bradford supply[5]	(G)	41407	94	99	99	91	76	58	66
Anglian	Grafham	(R)	58707	88	95	96	96	95	95	95
	Rutland	(R)	130061	71	74	82	82	81	81	79
Thames	London[6]	(G)	206232	88	91	100	93	86	85	90
	Farmoor [7]	(G)	13843	97	84	100	98	98	97	100
Southern	Bewl	(R)	28170	54	62	70	73	71	64	75
	Ardingly	(R)	4730	89	100	100	100	100	88	100
Wessex	Clatworthy	(R)	5364*	82*	82*	85*	77*	65*	43*	59*
	Bristol WW [8]	(G)	38666*	65*	71*	86*	80*	71*	61*	71*
South West	Colliford	(R)	28540	81	80	82	80	71	66	90
	Roadford	(R)	34500	87	89	92	91	83	75	95
	Wimbleball[9]	(R)	21320	77	79	79	76	63	53	73
	Stithians	(R)	5205	45	52	65	69	61	54	66
Welsh	Celyn + Brenig	(G)	131155	97	100	100	100	99	87	89
	Brianne	(R)	62140	100	100	100	97	88	77	93
	Big Five[10]	(G)	69762	92	97	98	92	77	66	92
	Elan Valley[11]	(G)	99106	100	100	100	96	91	87	87
Lothian	Edinburgh/Mid Lothian	(G)	97639	96	100	100	98	87	79	84
	West Lothian	(G)	5613	91	94	85	76	60	49	72
	East Lothian	(G)	10206	98	99	89	91	81	72	86

● Live or usable capacity (unless indicated otherwise)
* Gross storage/percentage of gross storage

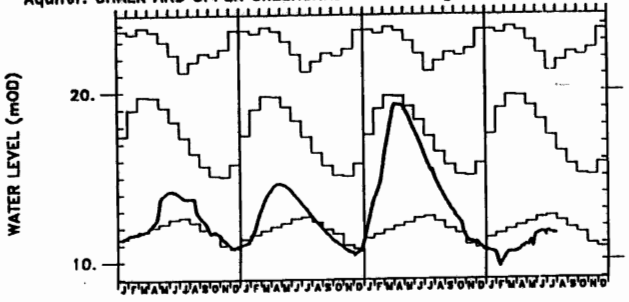
1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. Lower Thames (includes Queen Mother, Wraysbury, Queen Mary, King George VI and Queen Elizabeth II) and Lee Valley (includes King George and William Girling) groups - pumped storages.
7. Farmoor 1 and 2 - pumped storages.
8. Blagdon, Chew Valley and others.
9. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
10. Usk, Talybont, Llandegfedd (pumped storage), Taf Fechan, Taf Fawr.
11. Claerwen, Caban Coch, Pen y Garreg and Craig Goch.

Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient use of water stocks will further affect reservoir storages. Table 4 provides a link between the hydrological conditions described elsehwere in the report and the water resources situation.

FIGURE 3 GROUNDWATER HYDROGRAPHS

Site name: DALTON HOLME

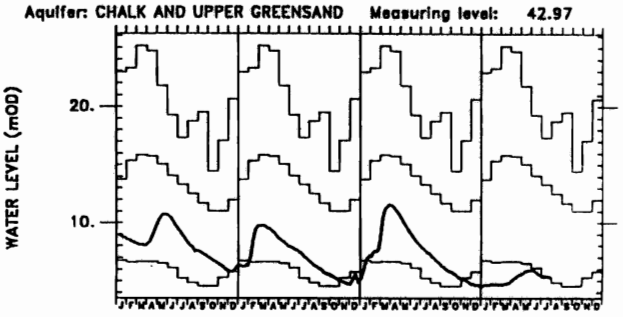
National grid reference: SE 9651 4530 Well number: SE94/5
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 34.50



Max, Min and Mean values calculated from years 1889 TO 1989

Site name: LITTLE BROCKLESBY

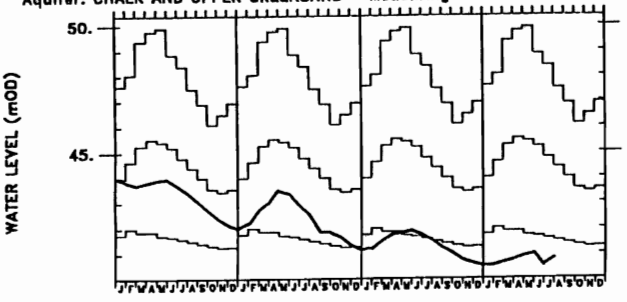
National grid reference: TA 1371 0888 Well number: TA10/40
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 42.97



Max, Min and Mean values calculated from years 1926 TO 1989

Site name: WASHPIT FARM

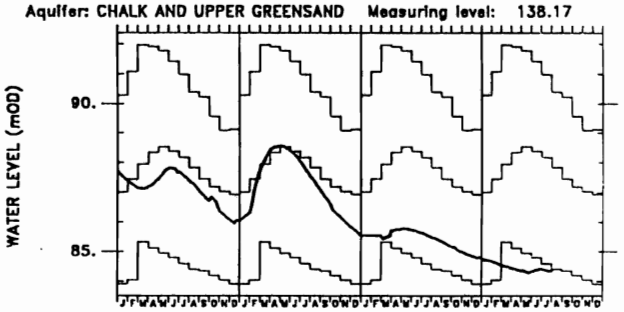
National grid reference: TF 8138 1960 Well number: TF81/2
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 80.20



Max, Min and Mean values calculated from years 1950 TO 1989

Site name: THE HOLT

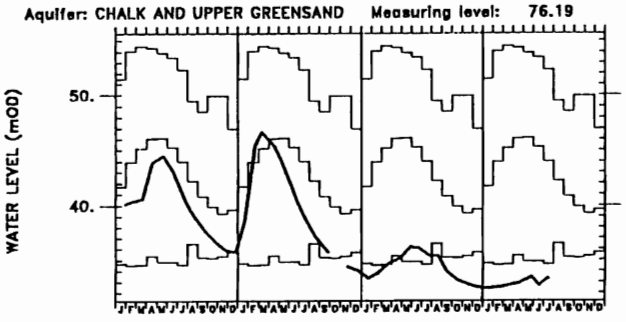
National grid reference: TL 1692 1965 Well number: TL11/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 138.17



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: REDLANDS HALL,ICKLETON

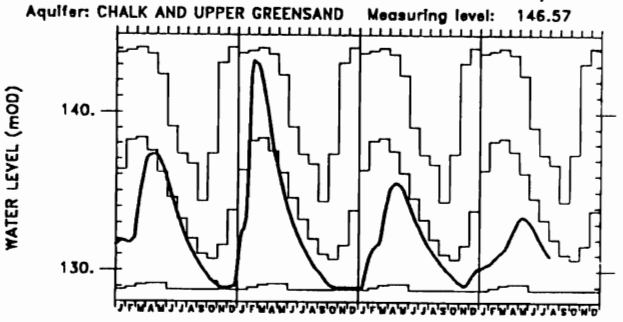
National grid reference: TL 4522 4182 Well number: TL44/12
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 76.19



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: ROCKLEY

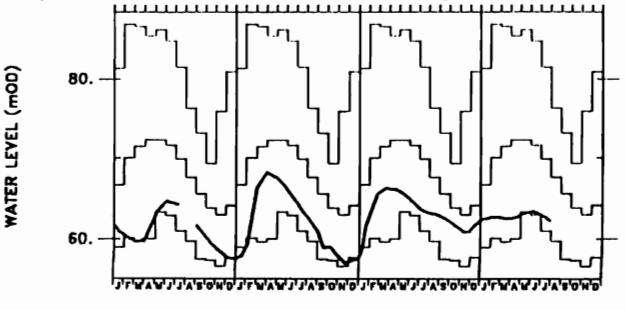
National grid reference: SU 1655 7174 Well number: SU17/57
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.57



Max, Min and Mean values calculated from years 1933 TO 1989

Site name: LITTLE BUCKET FARM,WALTHAM

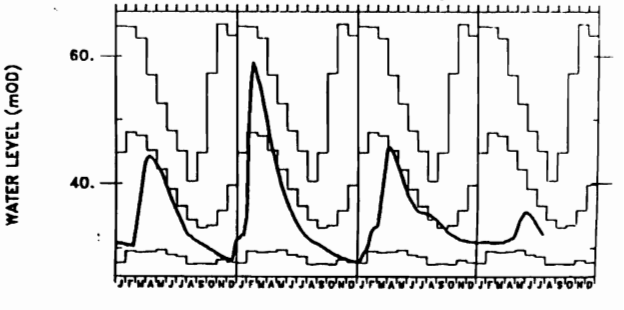
National grid reference: TR 1225 4690 Well number: TR14/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 87.33



Max, Min and Mean values calculated from years 1971 TO 1989

Site name: COMPTON HOUSE

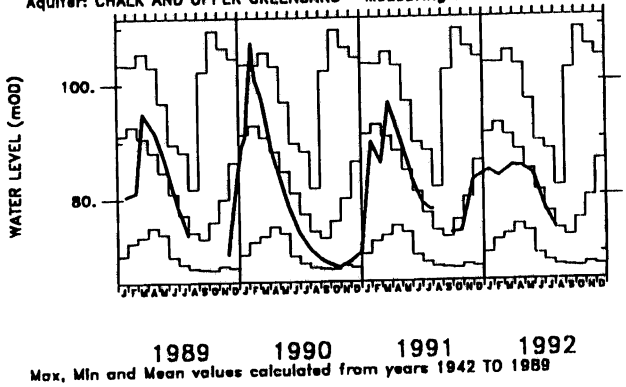
National grid reference: SU 7755 1490 Well number: SU71/23
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



Max, Min and Mean values calculated from years 1894 TO 1989

Site name: WEST WOODYATES MANOR

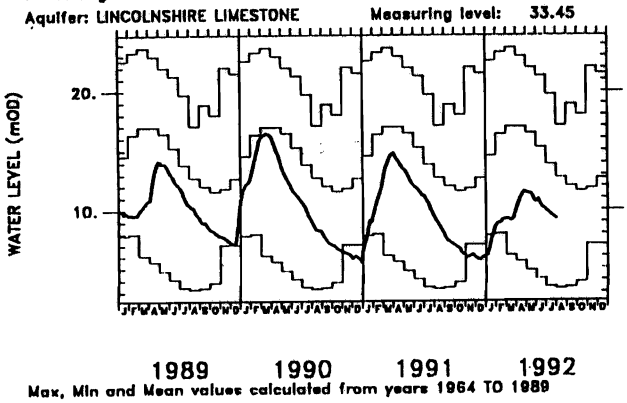
National grid reference: SU 0160 1960 Well number: SU01/58
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 110.88



Max, Min and Mean values calculated from years 1942 TO 1989

Site name: NEW RED LION

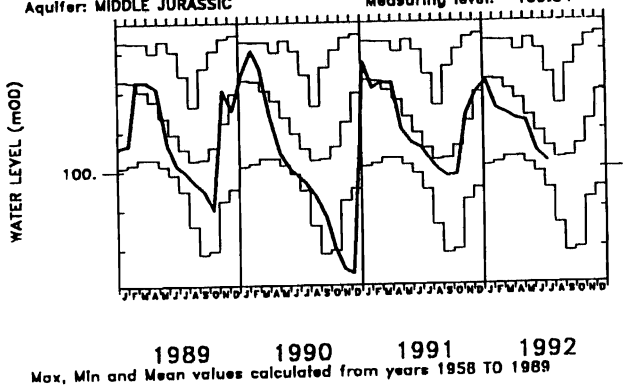
National grid reference: TF 0885 3034 Well number: TF03/37
Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.45



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: AMPNEY CRUCIS

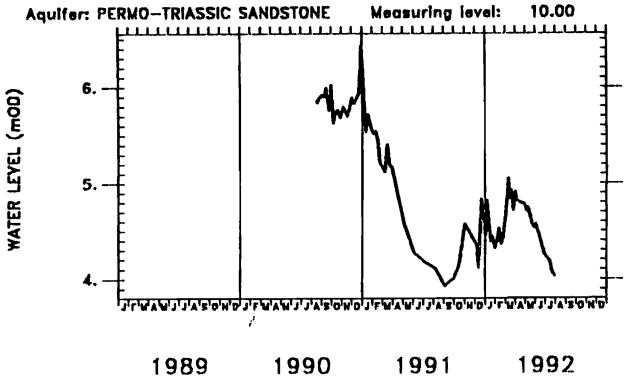
National grid reference: SP 0595 0190 Well number: SP00/62
Aquifer: MIDDLE JURASSIC Measuring level: 109.54



Max, Min and Mean values calculated from years 1958 TO 1989

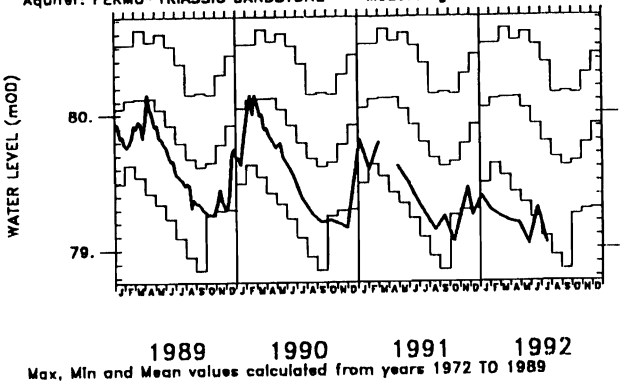
Site name: REDBANK

National grid reference: NX 9667 7432 Well number: NX97/1
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 10.00



Site name: LLANFAIR DC

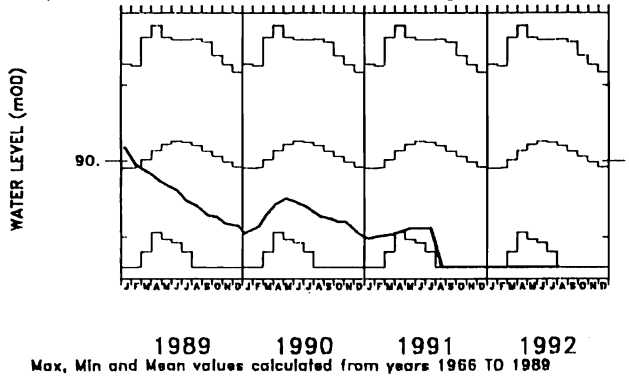
National grid reference: SJ 1374 5556 Well number: SJ15/15
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 83.08



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: WEEFORD FLATS,WEEFORD

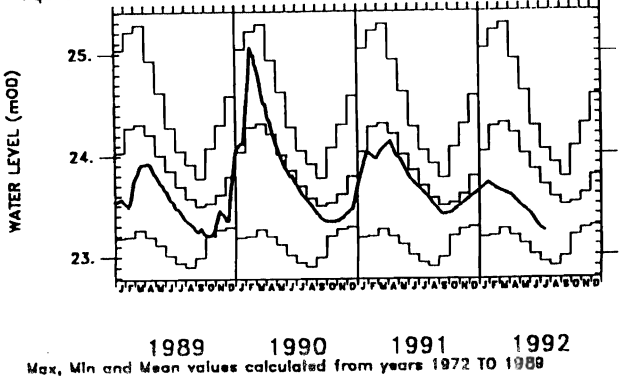
National grid reference: SK 1440 0464 Well number: SK10/9
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 96.21



Max, Min and Mean values calculated from years 1966 TO 1989

Site name: BUSSELS NO.7A

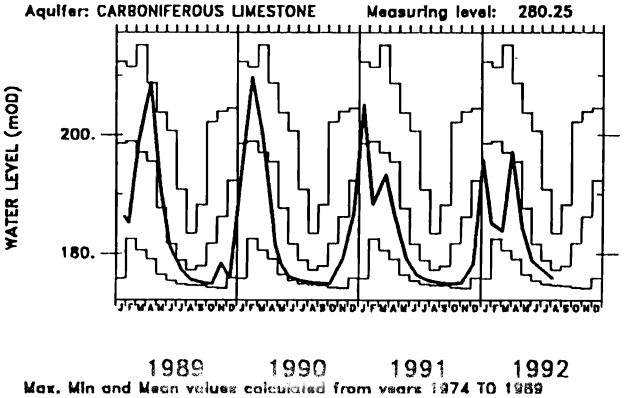
National grid reference: SX 9528 9872 Well number: SX99/378
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.97



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: ALSTONFIELD

National grid reference: SK 1292 5547 Well number: SK15/16
Aquifer: CARBONIFEROUS LIMESTONE Measuring level: 280.25



Max, Min and Mean values calculated from years 1974 TO 1989

TABLE 5 A COMPARISON OF JULY GROUNDWATER LEVELS : 1992, 1991 AND 1976

Site	Aquifer	Records commence	Average July Level	July 1976		July 1991		July and August 1992		No of years July levels <1992	Lowest pre-1992 level (any month)
				Day	Level	Day	Level	Day	Level		
Wetwang	C & UGS	1971	20.91	14/07	19.00	27/07	19.32	29/07	18.75	1	16.84
Dalton Holme	C & UGS	1889	17.39	31/07	13.00	25/07	15.40	30/07	11.51	0	10.34
Little Brocklesby	C & UGS	1926	13.30	30/07	5.26	30/07	7.33	29/07	5.30	1	4.54
Washpit Farm	C & UGS	1950	44.77	01/07	42.20	01/07	41.75	03/08	40.77	0	40.61
The Holt	C & UGS	1964	88.16	29/07	85.00	28/07	85.51	03/08	84.32	0	83.90
Therfield Rectory	C & UGS	1883	81.50	28/07	74.22	28/07	73.79	04/08	dry	3	dry (below 71.60)
Redlands Farm	C & UGS	1964	44.00	01/07	37.20	22/07	35.42	17/07	33.28	0	32.46
Rockley	C & UGS	1933	133.24	29/07	dry	28/07	131.68	26/07	131.12	8	dry (below 128.94)
Little Bucket Farm	C & UGS	1971	69.88	13/07	60.97	22/07	63.29	28/07	62.25	2	56.77
Compton House	C & UGS	1894	36.44	22/07	28.75	31/07	35.23	24/07	32.01	8	27.64
Chilgrove House	C & UGS	1836	44.43	31/07	34.95	31/07	44.97	24/07	42.53	>10	33.46
West Dean No 3	C & UGS	1940	1.50	30/07	1.29	26/07	1.62	31/07	1.35	>10	1.01
Lime Kiln Way	C & UGS	1969	125.30	15/07	124.29	18/07	124.66	17/07	123.91	0	124.09
Ashton Farm	C & UGS	1974	66.96	20/07	65.44	01/07	66.90	03/08	65.50	4	63.10
West Woodyates	C & UGS	1942	77.06	01/07	69.73	26/07	77.70	03/07	74.40	>10	67.62
New Red Lion	LLst	1964	13.83	27/07	3.45	29/07	9.63	30/07	9.31	2	3.29
Ampney Crucis	Mid Jur	1958	100.54	25/07	99.48	22/07	100.26	10/07	100.16	>10	97.38
Dunmurry (NI)	PTS	1985	28.04	no	levels	27/07	27.73	29/07	27.81	3	27.47
Redbank	PTS	1981	4.61	no	levels	09/07	4.17	30/07	4.03	0	3.93
Llanfair DC	PTS	1972	79.79	01/07	79.09	21/07	79.26	19/07	79.04	0	78.85
Morris Dancers	PTS	1969	32.60	13/07	31.92	08/07	32.04	06/07	31.94	1	30.87
Weeford Flats	PTS	1966	90.25	14/07	88.81	19/07	89.12	05/08	dry	0	dry (below 88.61)
Bussels 7A	PTS	1972	23.69	27/07	22.94	30/07	23.58	15/07	23.23	1	22.90
Rusheyford NE	MgLst	1967	76.15	27/07	65.67	17/07	75.42	07/07	74.64	>10	64.77
Peggy Ellerton	MgLst	1968	34.62	26/07	31.30	09/07	33.32	09/07	31.53	1	31.10
Alstonfield	CLst	1974	178.95	21/07	174.90	25/07	175.64	05/08	175.95	8	174.22

Groundwater levels are in metres above Ordnance Datum

C & UGS	Chalk and Upper Greensand	Mid Jur	Middle Jurassic limestones
LLst	Lincolnshire Limestone	MgLst	Magnesian Limestone
PTS	Permo-Triassic sandstones	CLst	Carboniferous Limestone

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS